Global pressures vs. local embeddedness: the de- and restabilization of the Estonian oil shale industry in response to climate change (1995–2016)

Article (Accepted Version)

Global pressures and local embeddedness: The interaction of de- and restabilizing mechanisms in the Estonian oil shale industry (1995-2016)

Abstract

Existing literature on energy transitions lacks a systematic account of how the destabilization of incumbent carbon-intensive industries is influenced by their socio-spatial embeddedness on regional, national and global scales. This might result in overestimating the potential for reorientation in old industrial regions. Combining the Dialectic Issue LifeCycle (DILC) model with insights from the geography of transitions, we analyse the destabilization of the Estonian oil shale industry in response to climate change between 1995 and 2016. The findings show that the embeddedness of the industry on regional and national scales, reproduced by a number of different strategies, has served as a vital source of restabilization in the face of global destabilizing pressures. Policies aimed at redirecting incumbent unsustainable industries need to start from disembedding them from their socio-spatial ties.

Keywords: energy transitions, industry destabilization, geography of transitions, socio-spatial embeddedness, policy-industry alliances

1. Introduction

The destabilization of incumbent industries has recently gained attention in the literature on energy transitions (Penna and Geels, 2012, 2015; Karltorp and Sandén, 2012; Turnheim and Geels, 2012, 2013; Ottosson and Magnusson, 2013; Bosman et al., 2014; Geels and Penna, 2015; Kungl and Geels, 2017; Roberts, 2017; Rosenbloom, 2018; Sovacool et al., 2017). Existing research has demonstrated that the destabilization of unsustainable industries is a multi-dimensional struggle involving techno-economic and socio-political pressures of varying intensity, heterogeneous responses from industry actors, temporary setbacks and reversals (Penna and Geels, 2015), and various possibe outcomes on the industry ranging from dissolution (Sovacool et al., 2017) to reorientation (Kungl and Geels, 2017). This focus is timely given that global environmental problems like climate change necessitate a radical transformation of fossil fuel based energy industries. However, the literature on carbon lock-in (Unruh, 2000; Unruh, 2002; Unruh and Carrillo-Hermosilla, 2006), path dependency (Arthur, 1994; Pierson, 2000), entrapment (Walker, 2000) and technological momentum (Hughes, 1994) suggests that, more often than not, incumbent industries tend to remain remarkably resilient to change even in the face of major destabilizing pressures. From the industry destabilization perspective this raises a challenge of dealing with cases in which the preconditions for large-scale industrial transformation seem to be present yet little of it actually occurs. It implies a need to account for both the mechanisms facilitating industrial change as well as the ones hindering it.

This paper is based on the intuition, derived from recent advances in the geography of transitions (Coenen et al., 2012; Coenen and Truffer, 2012; Raven et al., 2012; Truffer and Coenen, 2012; Bridge et al., 2013; Hansen and Coenen, 2015; Murphy, 2015; Truffer et al., 2015; Becker et al., 2016; Chandrashekeran, 2016; Haan, 2017; Hess et al., 2017; Ramiller and Schmidt, 2017), that the high degree of stability and lock-in that hinders the destabilization of incumbent industries has much to do with the ways in which they are embedded on regional and national scales. We therefore combine the Dialectic Issue LifeCycle Model (Penna and Geels, 2012) with insights from the geography of transitions to answer the following research questions:

1. what are the main forms of socio-spatial embeddedness of industries on different geographical scales and how do these affect industries?
2. how do global pressures interact with regional and national embeddedness and what is the result of this interaction on industrial change?

We explore these questions with a multi-method case study into the effect of the climate change agenda on the Estonian oil shale industry (at the core of the national energy regime) between 1995 and 2016. Section 2 provides an overview of existing literature followed by the outline of research methodology in section 3. Section 4 presents an empirical narrative of the sequence of events during the observed period along with detailed visual timelines. These findings are analysed in section 5. Section 6 concludes and summarizes the implications for theory and policy.

2. Theoretical framework

2.1. Destabilization of industry regimes

Recent literature on industry destabilization has focused on the interaction between the "industry regime" and its environment (Geels, 2014a). The industry regime is defined as a set of industry-specific rules (e.g. technical knowledge and capabilities, mindsets and values, regulations and standards) guiding the behaviour of and providing stability for industry actors. It is situated in two types of environments: 1) economic environment, consisting of various actors in direct commercial transactions with the industry (e.g. suppliers of resources and raw materials, finance, technologies, knowledge as well as consumers), and; 2) socio-political environment, consisting of policy-makers, civil society and the general public. Industry destabilization might therefore be described as a process in which the accumulated pressure from economic or socio-political environments (e.g. changing demand, increasing competition, normative contestation by activists, adoption of new laws) weakens the reproduction of core regime elements, eventually leading to either reorientation or bankruptcy for the industry (Turnheim and Geels, 2012; Turnheim, 2013).

Application of this framework to industry destabilization has shown that, when facing accumulating pressures from the external environment, industries react with various strategic responses such as economic positioning strategies (e.g. marketing, supply chain management), investments and innovation, corporate policy-making (e.g. lobbying) and framing (e.g. advertising, awareness campaigns) (Kungl and Geels, 2017). The Dialectic Issue LifeCycle (DILC) model (Penna and Geels, 2012, 2015; Geels and Penna, 2015) describes an ideal-typical progression of the destabilization process through chains of interactions between activists, consumers, new market entrants, policymakers and industry actors (table 1):

1. a specific issue within the industry (e.g. high carbon emission rates of fossil fuel industries contributing to climate change) is first framed by social activists while industry actors fail to recognize it or downplay its importance;
2. social movements are formed that push the issue on the public agenda and give rise to public concerns. Industry actors engage in defensive responses such as closed industry fronts while exploring incremental technological solutions;
3. policymakers become involved, creating investigative committees and organizing public debates. Industry actors bring up reasons why radical change is unnecessary or impossible. They promise to implement incremental solutions while secretly "hedging the bets" by exploring radical alternatives or diversifying into new product markets;
4. new substantial legislation is introduced and implemented by policymakers. Industry actors contest the new policies while increasing investment in R&D. A new market share emerges as "moral" consumers adopt early radical alternatives;
5. changes in policies, consumer preferences or public discourse bring about the rise of new markets. Some industrial actors see this as an opportunity to reorient towards new markets while also recreating themselves with a new identity and mission that addresses the issue at stake (Penna and Geels, 2015).

The DILC model provides a useful heuristic by encompassing insights on discursive destabilization (Bosman et al., 2014; Roberts, 2017), framing struggles (Geels and Verhees, 2011; Rosenbloom, 2018; Leipprand and Flachsland, 2018) and technological innovation (Karltorp and Sandén, 2012; Ottosson and Magnusson, 2013). However, we see two ways in which the model could be improved. First, although the proponents of the DILC model acknowledge that destabilization does not unfold in a linear fashion but in cyclical patterns where external pressures and industry responses move forwards and backwards between different phases (Geels and Penna 2015; Penna and Geels 2012, 2015), it remains somewhat unclear what explains these cyclical shifts. Geels (2014b) has suggested that one of the key factors might be political intervention on the local (regional or national) scale where industry actors tend to form close alliances with policymakers, thereby influencing political decisions in favour of the industry. Similarly, Turnheim (2012) has proposed that political intervention (or the lack of it) and the multi-level embeddedness of industries might be crucial in explaining the unfolding of the destabilization phases. Second, the DILC model is not particularly sensitive to the importance of geographical context: while in principle it allows for the possibility that pressures from the global environment might differ from those exerted by the regional and national context of industries, these distinctions have not been explored in empirical research.

Table 1. Accumulation of problem-related pressures and industry responses in the linear DILC model (based on Geels and Penna, 2015; Penna and Geels, 2015).

Actors	Problem mobilization in socio-political environment			Spillovers to economic environment	
	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Activists and social movements	problem framing	organization into movements, raising public concerns	organized framing and political lobbying		
Policymakers		expressing concerns, creating informal committees	engagement in political debates and formal hearings	implementation of substantive policies	policies influence economic frame conditions
Consumers and new entrants			early demand from "moral" consumers	growing "moral" market niches	changes in mainstream preferences
Industry	problem denial or downplaying	organization into closed industry front, domain defence by contestation, incremental innovation	radical solutions portrayed as unfeasible, hedging the bets	opposition to policies, diversification	re-orientation, re-creation or dissolution

2.2. Socio-spatial embeddedness of industries across multiple scales

In contrast to the literature on industry destabilization, the importance of place is strongly stressed by geographical approaches to transitions. Truffer and Coenen (2012) have invoked the notion of "socio-spatial embeddedness" to signify the multiple territorial, social and cultural advantages enjoyed by socio-technical regimes in particular locations. Examples of place-specific elements include urban and regional visions and policies, informal localized institutions (Hansen and Coenen, 2015; Raven et al., 2012), natural resource endowments, physical infrastructure (Bridge et al., 2013; Hansen and Coenen, 2015), regional technological and industrial specialization or the role of consumers in local market formation (Hansen and Coenen, 2015). Others have stressed the importance of linkages across national and global scales such as multi-level governance and policy mobilities (Hansen and Coenen, 2015; Sengers and Raven, 2015), buzz-pipelines, international transfer of knowledge, global production networks (Sengers and Raven, 2015), epistemic communities, transnational advocacy networks and the global civil society (Raven et al., 2012).

However, Hansen and Coenen (2015) note that while the increased emphasis on the geographical dimension of transitions has led to the acknowledgement of the important role of place and scale in transition dynamics as an empirical matter-of-fact, there is currently little generalisable knowledge about how this matters for transitions. In order to systematize existing insights, we thus draw on Hess's (2004) critical overview of the notion of embeddedness in the economic geography literature which distinguishes between three different dimensions of the concept:

1. territorial embeddedness: the extent to which an actor is "anchored" in particular territories or places;
2. societal embeddedness: the influence that the social and cultural background of the actors has on their action;
3. network embeddedness: the involvement of the actor in a social network, i.e. a structure of relationships among a set of actors regardless of their anchoring in particular places.

Figure 1 applies this typology to findings from geographical studies on transitions. We suggest that territorial embeddedness exhibits itself mainly on the regional scale while societal and network embeddedness can also indicate non-regional influences on the industry through national and global ties.

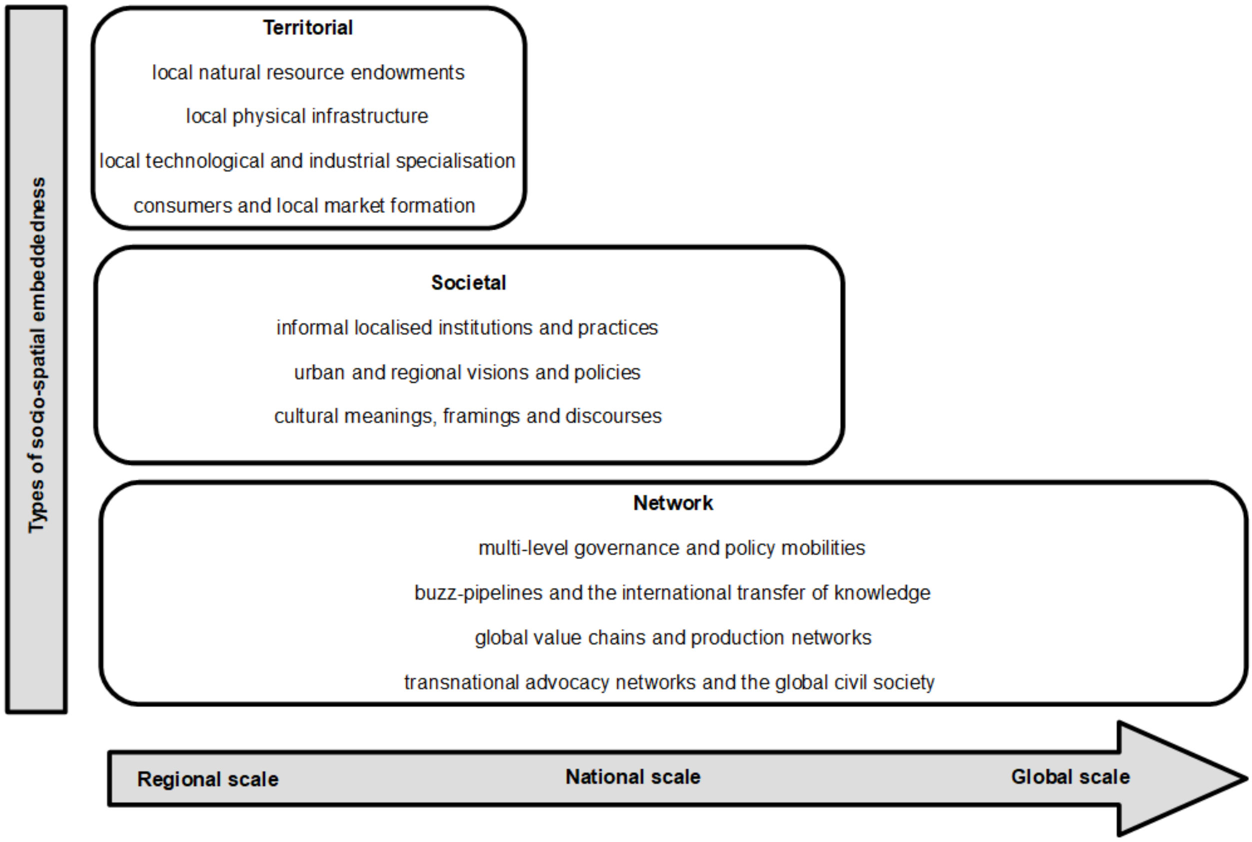

Figure 1. Types of socio-spatial embeddedness across multiple scales (based on Hess, 2004; Raven et al., 2012; Truffer and Coenen, 2012; Bridge et al., 2013; Sengers and Raven, 2015; Hansen and Coenen, 2015).

An important implication is that each of these forms of embeddedness can serve as a source of stabilization for incumbent industries. For example, an industry might draw on existing natural resource endowments, national energy strategies and/or favourable conditions in global energy markets – combining forms of territorial, societal and network embeddedness respectively – to neutralize destabilizing pressures and avoid radical change. The degree to which the industry is successful in doing so indicates the extent of its embeddedness across multiple scales.

2.3. Industrial change as a struggle between de- and restabilizing mechanisms

Based on the above discussion, we treat industrial transformation as a complex process that involves two forces pulling in opposite directions. On one hand, the DILC model (see table 1) provides a mechanism that explains how destabilizing pressures from the socio-political and economic environments lead to the gradual weakening and eventual reorientation of the industry regime. On the other hand, this pressure is countered by industry representatives (and possibly policymakers) on regional and national scales drawing on embedded territorial, societal and/or network ties and reinforcing them by a variety of strategies (figure 2). We propose that it is the outcome of the interaction of these two mechanisms that determines the degree to which the industry becomes reoriented.

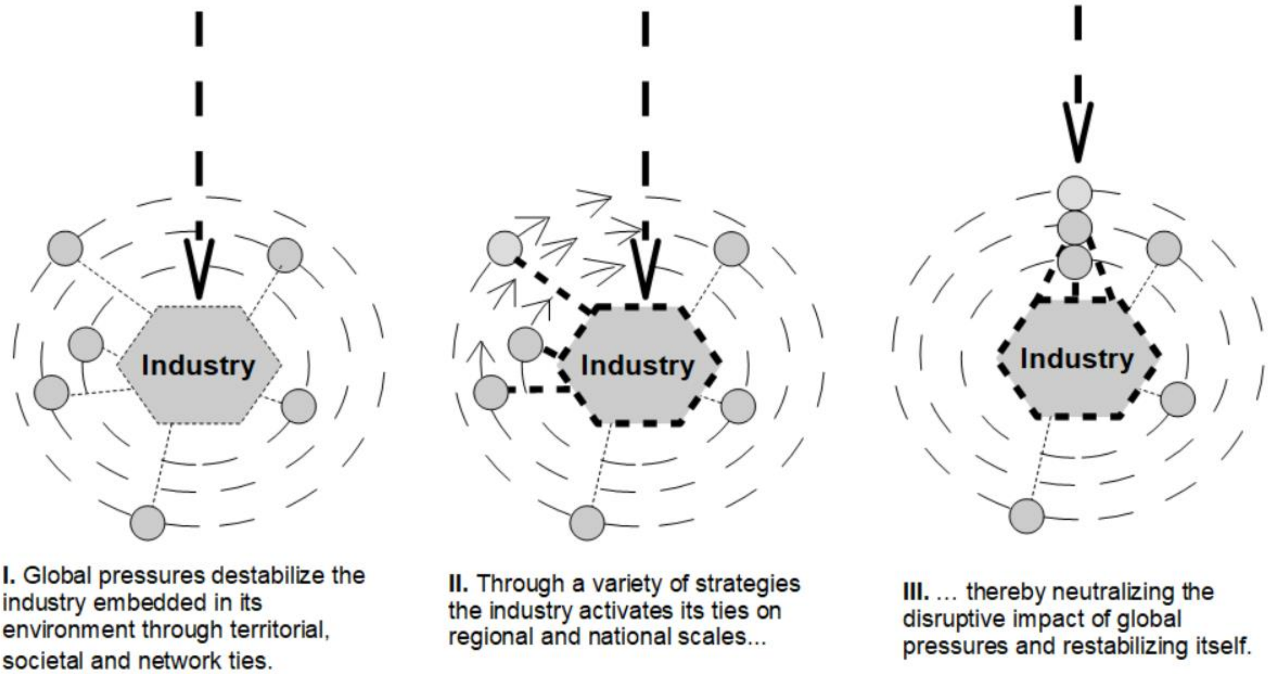

Figure 2. The interaction of destabilizing pressures and socio-spatial embeddedness of the industry. The dotted circles represent the three dimensions of embeddedness and the solid circles represent various elements from each dimension that can be mobilized and aligned by the industry as a response to external pressure, represented by the long dotted arrow.

The aim of rest of the paper is twofold: first, to uncover the underlying strategies by which industry actors reproduce the embeddedness on regional and national scales, and second, to explore the combined effect of destabilizing pressures and restabilizing strategies on industrial change.

3. Methodology

3.1. Case selection

The research was based on a single longitudinal case study design (Yin, 2003) following a deviant case selection strategy. A case is deviant if, by reference to a general theoretical understanding, it demonstrates a surprising and anomalous value (Seawright and Gerring, 2008). Selecting a deviant case is the most useful strategy for detecting omitted variables and mechanisms and discover unknown causal pathways (Seawright, 2016). While the Estonian oil shale industry has been previously analysed as an exemplary case of path dependency (Holmberg, 2008), it can be considered a deviant case in relation to existing theory on industry destabilization because of the following reasons:

1. the increasing pressure of the climate change agenda from the broader socio-political environment, affecting Estonia through its membership in international organizations (the EU and UN) and associated pledges (e.g. Kyoto protocol and Paris agreement);
2. the availability of alternatives indicated by the increasing cost-effectiveness of renewable energy technologies, affecting Estonia through global markets (REN21, 2018);
3. the low resilience of the Estonian energy industry regime because of its reliance on oil shale. The problems include a low Energy Return of Investment of oil shale compared to traditional liquid fuels (Cleveland and O’Connor, 2011; Hall et al., 2014) as well as the large negative impact on the environment as producing energy from oil shale emits twice as much greenhouse gases than from conventional fossil fuels (Cleveland and O’Connor 2011). Due to the impact of the oil shale industry, Estonia has one of the largest ecological footprints per capita in Europe (Global Footprint Network, 2017).

One should expect the combination of these factors – intensifying broader environmental pressures, increasing viability of alternatives and the fragility of the oil shale based energy regime – to have had a substantial impact on the Estonian industry regime toward destabilization and reorientation. Yet the actual share of oil shale in Estonian primary energy supply has remained fairly stable at 75% over the last two decades (Statistics Estonia, 2019a). The discrepancy between observed pressures and relative stability of the industry regime makes the Estonian case a deviant one, implying the presence of mechanisms continuously working to neutralize destabilizing pressures.

3.2. Estonian energy system and the oil shale industry

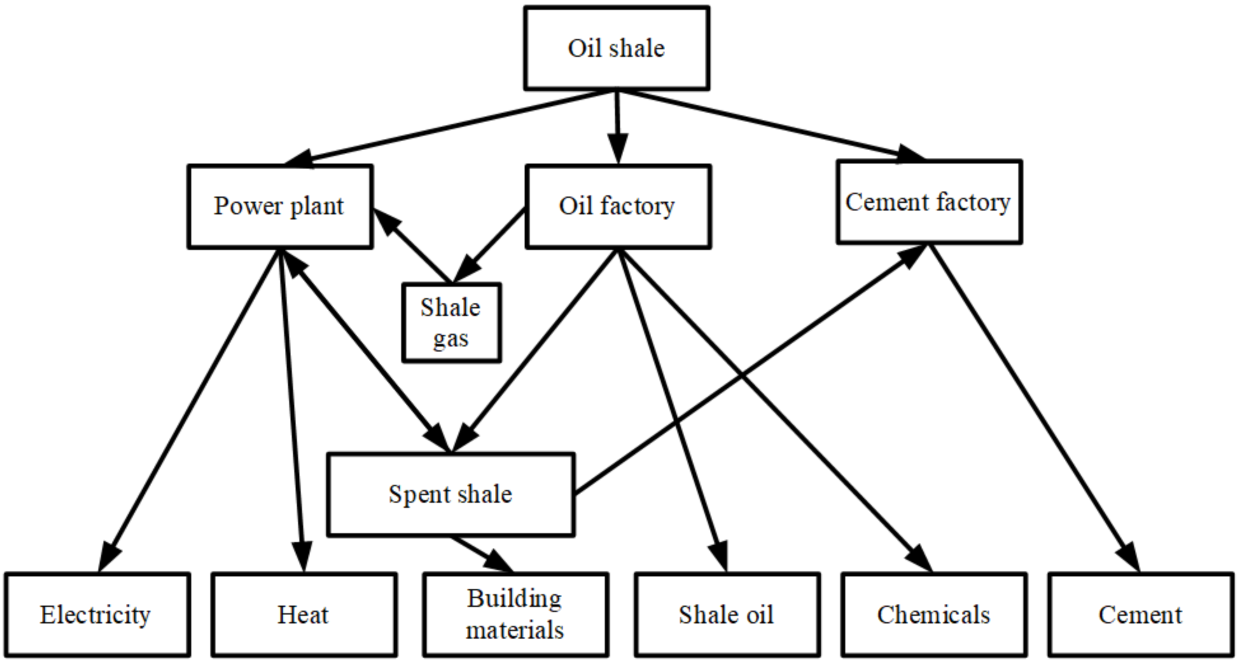

Figure 3. Industrial usage of oil shale (KPMS, 2015).

About 85% of electricity in Estonia is produced from oil shale and the overall share of oil shale in primary energy supply is around 75% (Statistics Estonia, 2019a). A distinctive aspect of the energy system is the degree of centralization and concentration, both in political and geographical terms. All oil shale mining areas as well as the main power plants are situated in the north-eastern part of the country near the Russian border (figure 8), a predominantly Russian-speaking region with relatively high rates of unemployment (Statistics Estonia, 2019b). As for the industry, the main energy supplier is the state-owned Eesti Energia which produces over 90% of all electricity in Estonia. However, the industry is not limited to the energy sector as oil shale is also used for the production of shale-oil-based fuels and chemicals, with the privately-owned Viru Keemia Grupp (known before 1999 as Kiviter) being a key player in this area, as well as cement and building blocks (figure 3).

3.3. Data collection and analysis

The case study employed a process-tracing approach (Beach and Pedersen, 2013). Process-tracing is a technique for causal inference developed to detect whether a specific causal mechanism mediating between certain initial conditions (e.g. pressure of climate change) and an outcome (e.g. industry reorientation) exists or not. It involves a systematic search for and combination of various pieces of empirical evidence to demonstrate the existence and interaction of mechanisms. For this purpose, we collected and combined data from multiple sources, including 1) 603 online news items about environmental problems related to the oil shale industry from the two biggest Estonian online news portals *Postimees* and *Delfi*, covering the period between 1995 and 2016[1]; 2) official public documents such as annual reports and yearbooks of the enterprises in the oil shale industry and the Estonian Renewable Energy association, as well as the strategies and development plans of the Ministry of Environment and the Ministry of Economic Affairs and Communications of Estonia; 3) secondary literature to find additional evidence about the activities of policy-makers and industry actors; 4) statistical databases and public opinion polls representing environmental pressures on the industry.

Data analysis proceeded in four consecutive steps:

1. visual observation of time series data to divide the case into periods. As an indicator of socio-political pressure, we counted the number of articles on climate change in *Delfi* and *Postimees*. As an indicator of economic pressure, we used the average annual OPEC crude oil price (Statista, 2019) because the competitiveness of the oil shale industry depends to a large extent

[1] The newspaper items were found with a Boolean search in the databases of *Postimees* and *Delfi* by using the key words (*põlevkivi* AND *kliima*) OR (*põlevkivi* AND *keskkond*). The results of the search were then manually reviewed and any articles that were judged to be irrelevant to the research problem were eliminated.

on the fluctuations of world crude oil price, with low oil price resulting in the loss of revenue for the industry (Eesti Energia et al., 2016). Figure 4 provides a visual representation of the periods in the context of socio-political and economic pressures and the changes in the energy mix (expressed as the ratio of oil shale to renewable energy supply);

2. content analysis of online news items to identify key actors, problem framings and events. The initial coding was done according to the categories of the DILC-model (see parts 1 and 2 of Appendix A). Open coding was used for the evidence on socio-spatial embeddedness (see part 3 of Appendix A);
3. the findings of the quantitative content analysis were amended with qualitative evidence from public documents and secondary sources in order to establish the main event sequences and identify the basic patterns of destabilization in the empirical data (see figures 5, 7, 9 and 10) and, on the basis of that, to construct detailed narratives of each period. Hence, we follow previous transition research in using narrative as a method to explain complex social processes (Abell, 2004). The narratives describe a) the main destabilising pressures on the industry from activists and social movements, policymakers and consumers and new market entrants and; b) industry responses ranging from problem denial to re-orientation. The figures complement the narratives in helping to differentiate between the global, national and regional scales;
4. as a final step, we used the pattern-matching technique (Seawright, 2016; Yin, 2003) to compare the observed pattern of destabilization with the ideal-typical pattern of the DILC model. The empirical patterns unexplained by the DILC model (e.g. strong stabilizing activities in late phases) were then sorted and analysed according to the categories of socio-spatial embeddedness in order to uncover the ways in which the industry was re-stabilized.

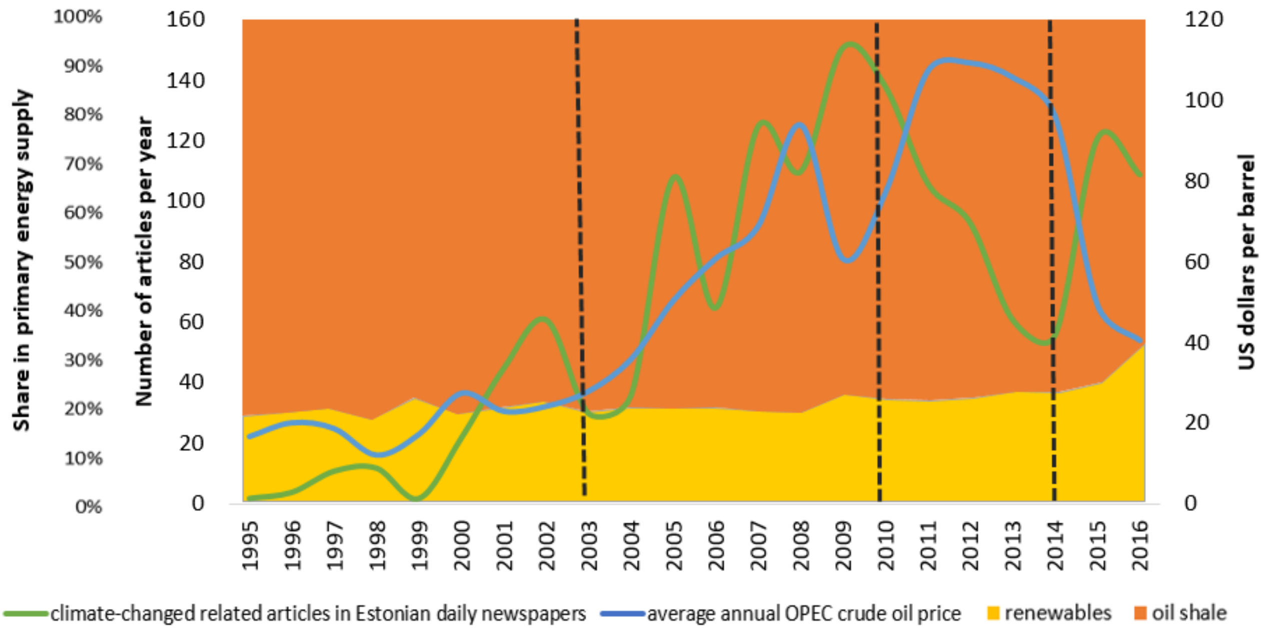

Figure 4. Periodization of the case based on proxies of economic and socio-political pressures and changes in the share of primary energy supply**. Sources:** Statista (2019), Statistics Estonia (2019a) and newspaper data gathered by the authors from *Postimees* and *Delfi*.

4. The destabilization of the Estonian oil shale industry (1995–2016)

4.1 Framing of the climate change issue and post-Soviet economic struggle (1995–2002)

The oil shale industry had for long been grappling with severe problems caused by the Soviet industrial heritage which were made worse by the quick transition to market economy after Estonia gained independence in 1991. Huge investments into new technologies were needed as the pulverized fuel combustion technology developed in the 1930s was, in addition to being economically inefficient, causing serious air pollution and waste problems (Majandus- ja Kommunikatsiooniministeerium, 2009). However, the firms were struggling with large debt and the government had made several exceptions for the industry, e.g. implementing pollution and waste charges that were 10 times smaller than the charges for similar toxic waste in other sectors (Valdmaa, 2014). Consequently, little effort was put into recycling the spent shale that was the by-product of the dry distillation process and the waste was simply dumped in big piles around the industrial area of Ida-Virumaa that eventually formed distinctive hills on the landscape.

Doubts over the economic and environmental sustainability of oil shale use sparked a wider debate about the future of the national energy system. The Estonian Green Movement proposed a new long-term plan for the utilization of alternative energy sources until 2050 which argued for the advantages of renewables and a decentralized energy system. However, these proposals were largely ignored by both policymakers and industry representatives who supported an oil shale based system (Delfi, 28.08.2001). They stressed that the survival of the industry was crucial for energy security as well as employment in the mainly Russian-speaking industrial region – arguments that both policymakers and industry representatives have regularly relied on over the years (figure 6).

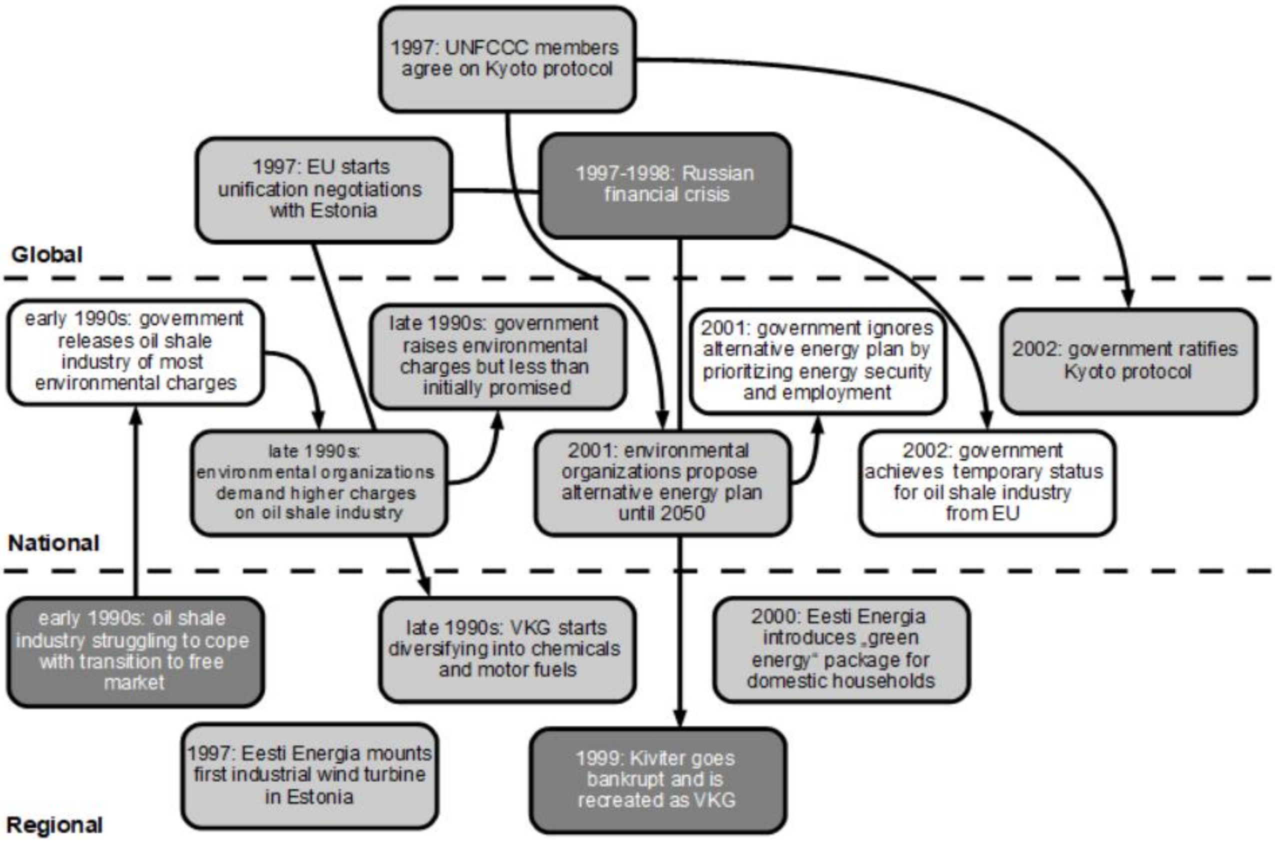

Figure 5. Sequence of events in the first period (1995-2002). Dark gray indicates strong destabilization (phases 4-5 of the DILC model), light gray modest or weak destabilization (phases 1-3 of the DILC model) and white stabilization. Continuous lines indicate event sequences within the period, dashed lines indicate continuities from the previous period.

The problem of climate change slowly started to gain public attention. In 1994, Estonia ratified the United Nations Framework Convention on Climate Change (UNFCCC), becoming a member of the countries dedicated to fighting against global warming. The year 1997 saw the international adoption of the Kyoto protocol which was ratified by Estonia in 2002. With this step, Estonia took an obligation to reduce its greenhouse gas emissions by 8% by 2012. At the same time, however, the government was making preparations for joining the European Union. With regard to the oil shale industry, the aim was to achieve exceptions from some of the EU environmental directives in order to assure the survival and further development of the sector (Postimees, 18.10.2002). The EU agreed to give oil shale a temporary status, including: 1) a prolonged deadline until 2016 for the renovation of the old power plants to meet the EU air quality standards; 2) a prolonged deadline until 2013 for the transition to an open electricity market and; 3) financial support for research and development of best available technologies (BATs) for energy and shale oil production.

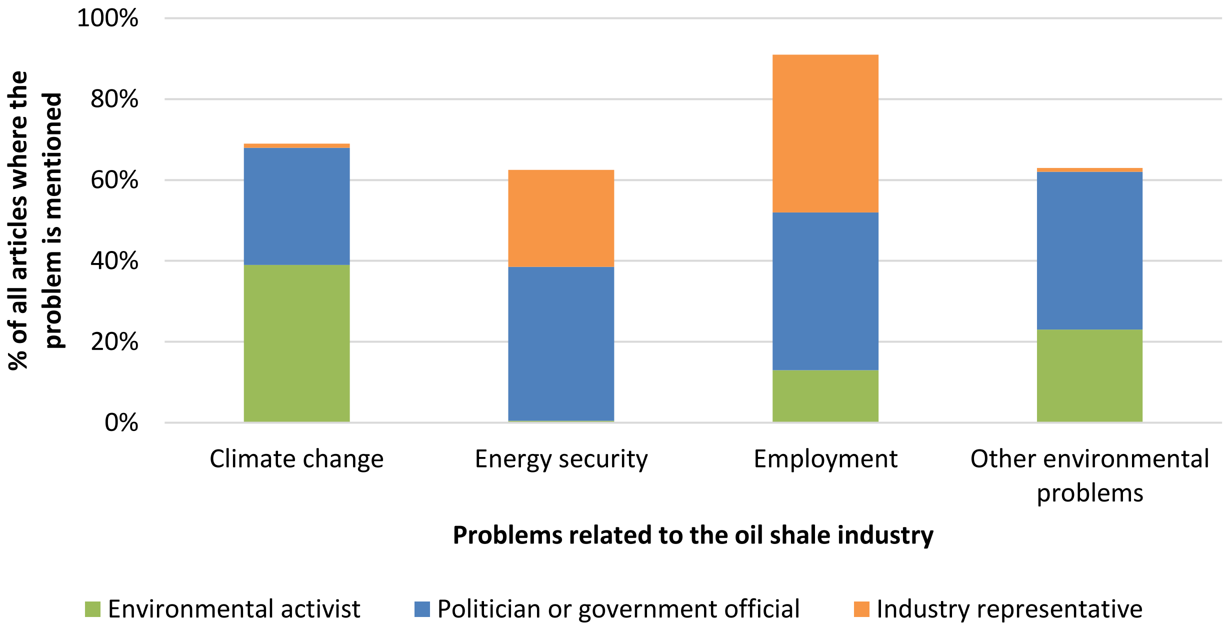

Figure 6. Actor groups and oil shale related discourse in Estonian daily newspapers, 1995-2016 (expressed as % of all articles where any oil shale related problems were mentioned). **Notes:** The data was collected by the coding of online news items based on the categories A4.2-4, B1.1, C1.1-2 and C1.6 in Appendix A.

The unification negotiations with the EU clearly influenced the strategic decisions of the industry. For example, the new-born Viru Keemia Grupp (VKG) shifted its focus on R&D into BATs for oil production as well as diversification into fine chemical products and motor fuels produced from recycled car tires. As for renewables, in 1997 Eesti Energia mounted its first industrial 150 kW wind turbine off the coast of Hiiumaa. Early demand for renewables from "green" consumers was indicated by the fact that Eesti Energia started offering a "green energy package" for domestic households in 2000. However, these early investments into renewable energy remained rather small-scale in comparison to oil shale projects.

4.2. Joining the EU, oil shale "rush" and incremental innovation (2003–2009)

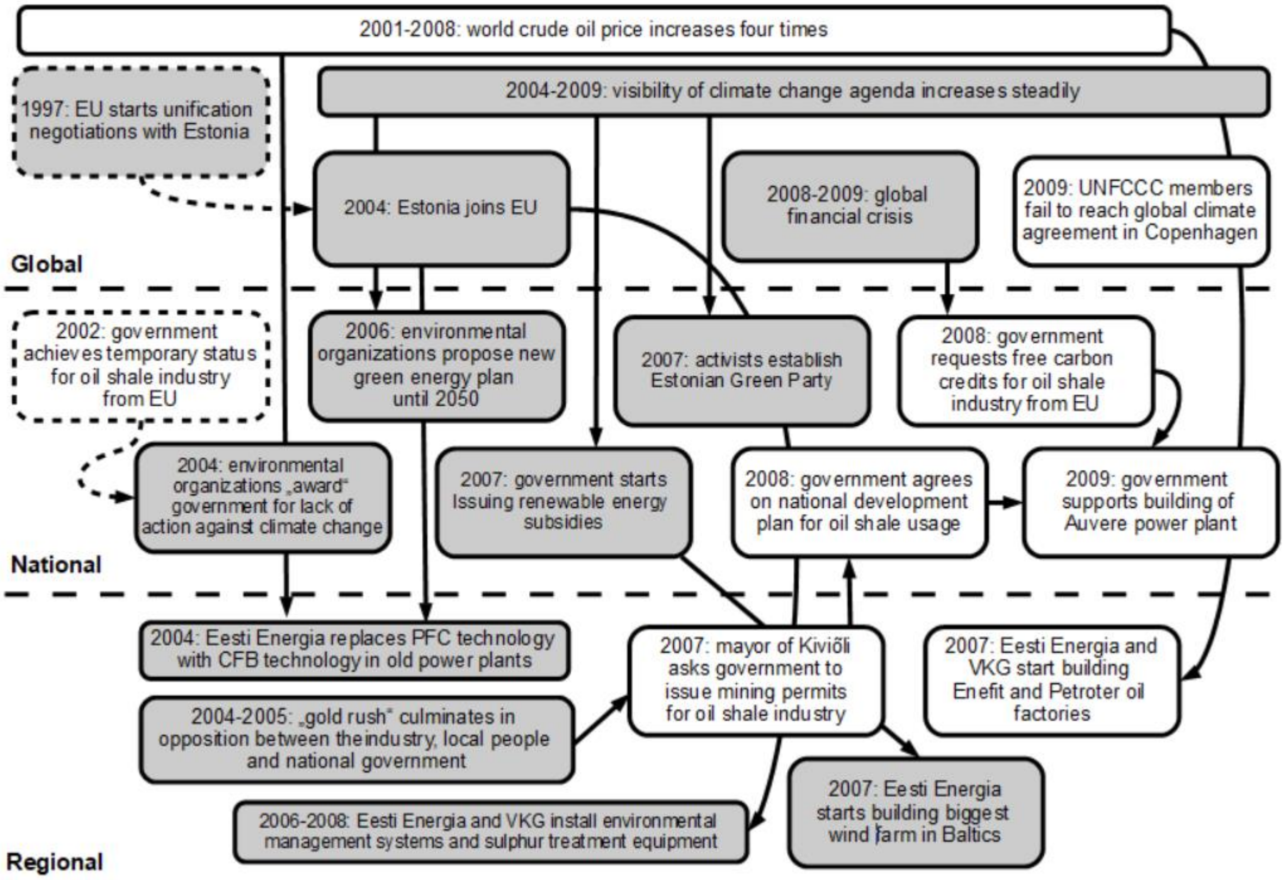

Figure 7. Sequence of events in the second period (2003-2009). Dark gray indicates strong destabilization (phases 4-5 of the DILC model), light gray modest or weak destabilization (phases 1-3 of the DILC model) and white stabilization. Continuous lines indicate event sequences within the period, dashed lines indicate continuities from the previous period.

The actions of the government following the ratification of the Kyoto protocol and joining the EU did not live up to the expectations of climate activists and in 2004 the Minister of Environment was presented with an annual "award" by the Estonian Green Movement for lack of action against climate change (Postimees, 17.07.2004). For the industry, Estonia's unification with the EU led to an urgent need to develop new technologies and build production facilities that would meet the stricter environmental standards. Environmental innovation was mainly focused on the installation of new environmental management systems and end-of-pipe technologies such as sulphur treatment equipment in old power plants. A major change by Eesti Energia in 2004 was the renovation of some old power plants in order to replace the old pulverized fuel combustion technology with the new circulating fluidized bed technology that allows to absorb a large part of the pollutants in the combustion process. These new investments were made possible by a long period of economic growth and a fourfold increase in the world crude oil price between 2001 and 2008.

Even bigger investments were made into oil production. Encouraged by the rocketing oil price, both Eesti Energia and VKG started developing new shale oil technologies (called Enefit and Petroter respectively) that would allow for the full utilization of oil shale and its by-products. The expansion of oil production also meant that the industry was in need of more oil shale. This led to a oil shale "rush" demonstrated by the increase in mining capacity and the expansion of mining areas in the early 2000s. As all of the potential mining sites were situated in North-Eastern Estonia (figure 8), this sparked opposition from environmental organizations and citizens in the region who were worried about the deterioration of air quality in nearby cities and the damage to the natural environment (Postimees, 20.09.2005). After meeting with the opposition, the government decided to stop issuing mining permits to companies until a national development plan for the usage of oil shale had been drawn up. The plan was finally agreed upon in 2008 and it prescribed an annual mining limit of 20 mln tonnes.

Figure 8. The location of actual (dark brown) and potential (light brown) oil shale resources in Estonia. **Source:** *Eesti põlevkivitööstuse aastaraamat 2014.*

The period also marked a significant expansion of the renewable energy sector as the overall share of renewables in final energy consumption increased from 16% in 2006 to over 25% in 2011. The development of the sector was supported by the government with the introduction of renewable energy subsidies in 2007 that enabled ongoing projects to be finished and some new projects to be planned. For example, the biggest industrial wind farm in the Baltic states was built by Eesti Energia in this period. However, the growth of the niche was mostly fueled by the use of biomass for heat generation in small-scale regional power plants while the perks of wind and solar energy remained largely unused (Eesti Taastuvenergia Koda, 2014).

4.3 State investments into oil shale and industry prosperity (2010–2013)

In 2007, the Estonian Green Party was established, winning 6% of the seats in the parliamentary election the following year. The party regularly raised awareness about climate change and, as a consequence, a poll conducted in 2010 found that climate change was acknowledged as the second biggest global environmental threat by Estonian people (Turu-uuringute AS, 2010). However, the increased public attention to climate change faded for a while after the failure to reach a much-anticipated global agreement on climate change at COP15 in 2009.

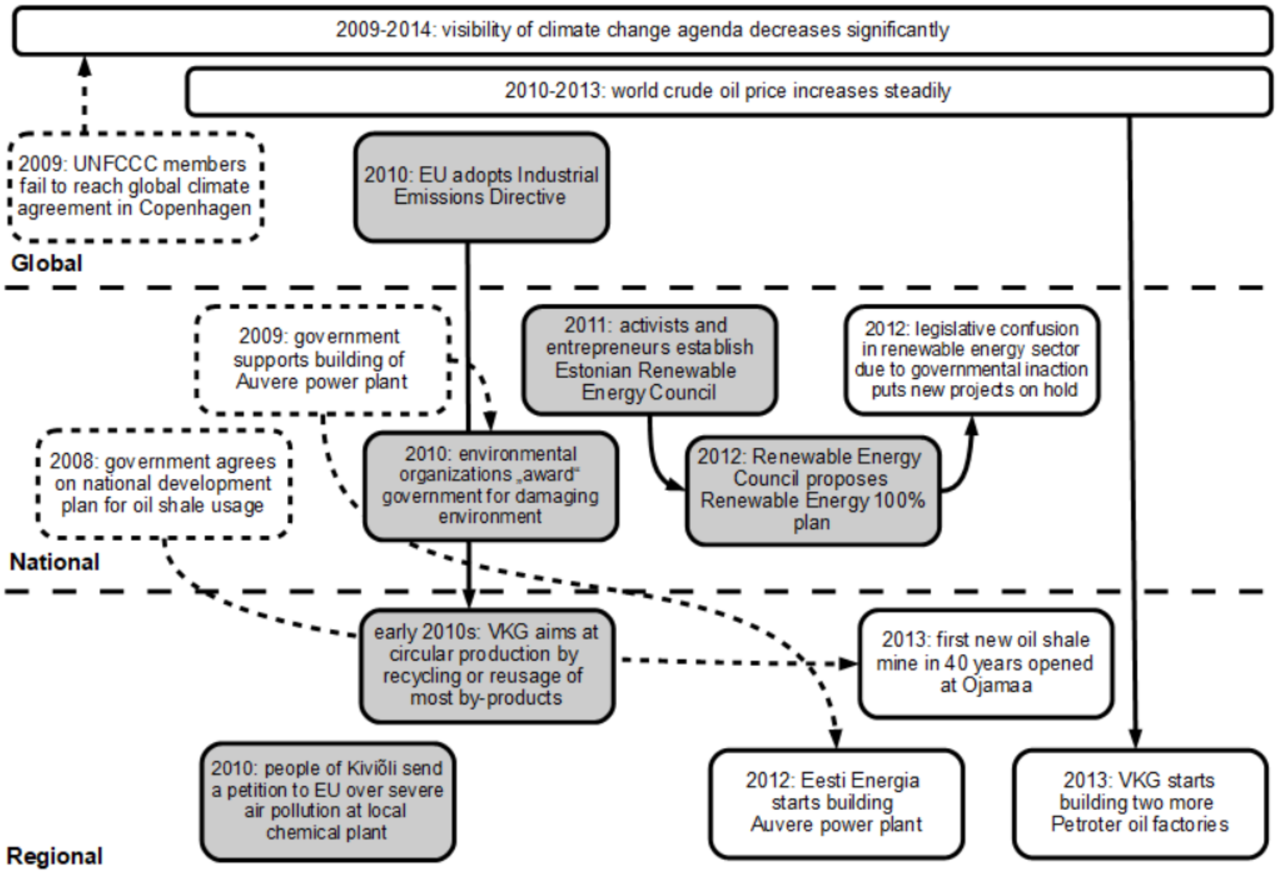

Figure 9. Sequence of events in the third period (2010-2013). Dark gray indicates strong destabilization (phases 4-5 of the DILC model), light gray modest or weak destabilization (phases 1-3 of the DILC model) and white stabilization. Continuous lines indicate event sequences within the period, dashed lines indicate continuities from the previous period.

On the national level, the government was criticized because of investments into Eesti Energia for the building of several new oil factories as well as a new 300 MW oil shale power plant at Auvere which represented the biggest state investment ever in Estonia. The investments were partly financed by free carbon credits requested by the government from the EU on behalf of the oil shale industry that absolved the industry from the obligation of paying any carbon emission charges (Delfi, 27.06.2012). The leaders of environmental organizations saw the decision as working against the EU energy and climate policy as well as national development plans which aimed at a more efficient use of oil shale by reorienting towards oil production instead of energy (Delfi, 13.02.2012). While Eesti Energia started building the Auvere power plant, VKG put lots of effort into the full utilization of oil shale and the recycling of by-products and residues. In spite of these developments, the carbon and sulphur emission rates of the industry still increased due to the opening of new Petroter oil factories (VKG, 2014).

At the same time, uncertainty prevailed in the renewables sector. Several projects were put on hold as previously introduced subsidies were cut and the government could not agree on new legislation (Eesti Taastuvenergia Koda, 2014). This was also evident in the share of renewable energy in final energy consumption which rose to 25% by 2011 but has not increased significantly since then. In 2011, renewable energy entrepreneurs and associations formed the Estonian Renewable Energy Council which quickly assumed the role of a vocal advocacy group. In 2012, it came forward with a new plan called Renewable Energy 100% which proposed a transition to a renewables-based energy system and included detailed analysis and steps for the transition to be achieved by 2030 (Delfi, 22.08.2012). The proposals were greeted by the chairman of the Estonian Green Party who said that "everything is ready for a shift to renewable energy" (Delfi, 29.08.2012).

4.4 Pressure alignment: oil price crisis and the Paris agreement (2014–2016)

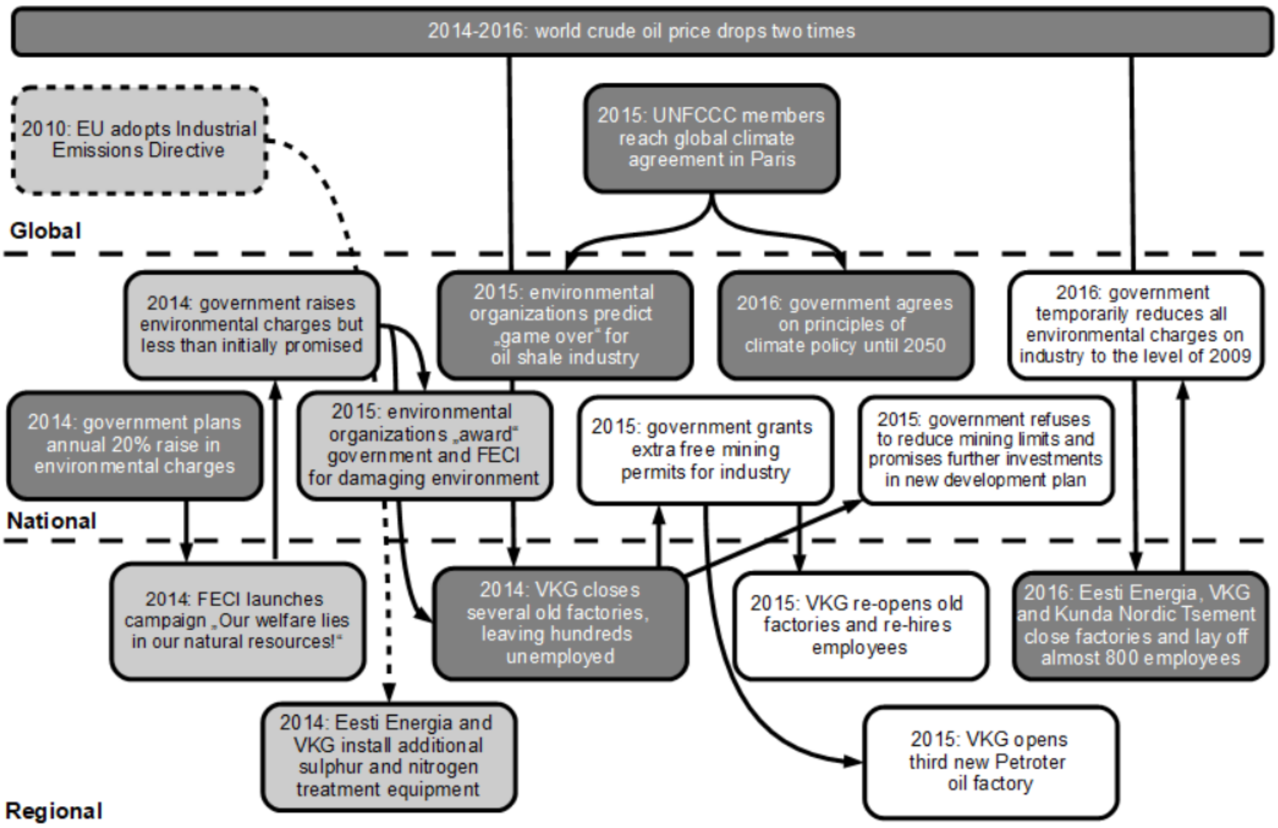

Figure 10. Sequence of events in the fourth period (2014-2016). Dark gray indicates strong destabilization (phases 4-5 of the DILC model), light gray modest or weak destabilization (phases 1-3 of the DILC model) and white stabilization. Continuous lines indicate event sequences within the period, dashed lines indicate continuities from the previous period.

In late 2014, the oil shale industry was hit by several simultaneous pressures which put it in a very difficult situation. First, there was an abrupt drop in the world crude oil price which fell by 50% between 2014 and 2016 (figure 4). At the same time, the government had proposed a rise in environmental charges by 20% annually which was met with opposition from the Federation of Estonian Chemical Industries (FECI) led by the representatives of the oil shale industry. FECI launched a campaign called “Our welfare lies in our natural resources!” the message of which was that the tax raises would lead to the bankruptcy of the industry (figure 11).

The organization claimed that, as a result of the tax raises, 24,000 people in Ida-Virumaa would become unemployed, annual tax revenue in the amount of 250 mln € would be lost and Estonia would lose its energy security and independence. The chairman of FECI stressed that there were no alternatives to fossil fuels and that “stories about wood and wind as the basis of our energy system belong to the fairy tale genre” (Delfi, 20.07.2014). The Ministry of Environment, the Renewable Energy Council and the Council of Environmental NGOs accused the federation of spreading false information and manipulating with public opinion (Delfi, 15.10.2014). A counter-campaign was launched by the environmental movements with the aim to renegotiate the meaning of energy security and promote renewable energy (figure 12).

Figure 11. Poster from the campaign “Our welfare lies in our natural resources!” (“How is it possible that Estonia is renouncing its energy security?”). **Source:** http://maavara.ee/.

Figure 12. Poster from the campaign "Energy security? – Yes! With renewable energy we will be independent!". **Source:** https://www.facebook.com/eestiroheline liikumine/.

As the oil price continued to fall, VKG temporarily closed several old oil factories in 2014, leaving hundreds of people suddenly unemployed. The unemployment crisis forced the government to act immediately and a plan was drawn up for a double reform proposed by the industry that would 1) make oil shale extraction charges dependent on the fluctuations of oil price and 2) allow for issuing extra mining permits free of charge for the industry. As a consequence, the people were re-hired by VKG and a third new oil factory based on the Petroter technology was opened a few months later (Delfi, 18.06.2015). In early 2016, however, VKG again laid off 500 employees, announcing that in these economic conditions, the company "could survive for no more than 24 months" (Delfi, 18.01.2016). Demands were made by the industry for a temporary reduction of all environmental charges and the government reacted quickly again by decreasing most of the tax rates on the industry to the level of 2009. The Renewable Energy Council commented that the "favouring of oil shale use has become a norm in Estonia that the lawmakers are not willing to change even in a drastically changed economic situation" (Delfi, 18.03.2016).

In the wake of COP21 in Paris, the government had started working on the first national climate strategy called "The Basis of Climate Policy until 2050", the main objective of which was an 80% reduction in greenhouse gas emission rates by 2050. This goal was to be achieved mainly by exporting oil and the emissions resulting from oil shale utilization. The document was criticized by environmental activists who stated that “climate change is a global problem and therefore attention should be paid to emissions resulting from the products made in Estonia regardless of whether these products are consumed here or exported” (Delfi, 16.08.2016). As the Paris agreement was successfully signed in late 2015, the prevailing opinion among activists was that the success of the Paris meeting meant “game over” for the oil shale industry (Delfi, 06.12.2015). However, in the same week, the Estonian parliament was discussing a new national development plan for the use of oil shale. According to the new plan, the mining limit would not be reduced in the next 15 years. Instead, the plan foresaw the opening of two new mines during that period as well as additional state investments of 5,7 mln € into new oil shale technologies (Keskkonnaministeerium, 2016). The Minister of Environment acknowledged that while Estonia would eventually need to stop relying on oil shale, there was no chance of that happening in the foreseeable future (Delfi, 14.12.2015).

5. Analysis and discussion

5.1. Pattern-matching with the DILC model

5.1.1. Increasing pressure from activists, consumers and new entrants

The increasing pressure from climate activists as well as consumers and new entrants fits with the general expectations of the DILC model (see table 1). In the case of activists, there is evidence of

- problem framing and increasing public visibility of the climate change agenda (establishment of the UNFCCC and organization of the annual COPs; adoption of the Kyoto protocol);
- growing public concerns over climate change and the unsustainability of oil shale energy (environmental organizations “awarding” the government for lack of action against climate change; citizens signing petitions and arranging public protests);
- increasing organization and lobbying by activists (establishment of the Green Party; environmental organizations proposing alternative renewable energy plans);

- the spillover of lobbying effects into official policy on the international (Paris climate agreement) as well as on the national scale (Basis of Climate Policy until 2050).

In the case of consumers and new entrants one can observe

- early demand from "green consumers" (which led to Eesti Energia introducing a renewable energy package for domestic households);
- the gradually increasing share of the renewable energy market niche (from 16% to over 25% of final energy consumption in the second period) and the emergence of an advocacy organization (the Estonian Renewable Energy Council).

Minor deviations in the actions of activists, consumers and new entrants can be attributed to the fluctuations in the world crude oil price and the visibility of the climate change agenda.

5.1.2. Policymakers and industry actors "hedging the bets"

The increasing pressure from activists, consumers and new entrants were met with mixed responses from policymakers and industry actors. In the first two periods (1995-2009), industry actors continued investments into oil shale while also experimenting with wind energy and biomass. Similarly, policymakers attempted to cater to the expectations of the industry while also addressing the emerging pressures for sustainability. This resulted in a paradoxical situation in which Estonia was implementing gradual ecological reforms to conform to the regulations of the EU while simultaneously negotiating exceptions for the oil shale industry from that very union. What is remarkable is the continuity of this approach despite multiple changes in the government, and the fact that these contradictory approaches were often pursued by the same policymakers.

The situation changed during the third period (2010-2013) when the temporary setback of the climate change agenda, combined with an abrupt rise in crude oil price, resulted in the dominance of immediate economic considerations, reflected in the increased investment activity by the industry supported by regional and national policy-makers. The fourth period (2014-2016) brought about another reversal of fortune, this time favouring the climate change agenda, while the paradoxical behaviour of policymakers became even more apparent. For example, both the Paris accord on climate change and a new national oil shale development plan (which foresaw further state investments into the industry over the next 15 years) were agreed on during the very same week at the end of 2015, with the Prime Minister of Estonia stating that the objectives of the two strategies were entirely compatible (Postimees, 16.12.2015).

The findings show that in contrast to the DILC model, not only industry actors but also policymakers have continuously pursued the "hedging the bets" strategy, simultaneously attempting to address both the climate change issue as well as pursuing new economic opportunities for the oil shale industry. On one hand, policymakers were looking to implement substantive new strategies such as "The Basis of Climate Policy until 2050" and the industry was diversifying into chemicals and fuels as well as renewable energy by building new wind parks (phase 4 of the DILC model). On the other hand, large-scale state investments were also made into new oil shale mines, power plants and oil factories while a substantial reorientation towards renewables in the energy sector was portrayed as unfeasible by the closed industry front (phase 3 of the DILC model).

In reality, policymakers resorted to merely expressing concerns about the need for climate action without actually moving forward with the implementation of the newly-adopted climate strategy (phase 2 of the DILC model). This led to a back-and-forth movement between the phases of the DILC model, eventually hindering the destabilization of the industry beyond phase 4. Remarkably, the hedging strategy continued even in the fourth period (2014-2016) in spite of the alignment of the pressures of increasing climate change agenda and decreasing world crude oil price on the industry. It has been observed elsewhere that this sort of risk aversion is, in fact, rather common among policymakers. This especially applies to issues like climate change characterized (until recently) by low visibility of impacts and low intensity of public concern, leading governments to implement only small scale (experimental) solutions in combination with symbolic procedural responses (Howlett, 2014). But how has this stance of risk avoidance been enforced and legitimized the industry and policymakers? To explain this, we turn to the role of socio-spatial embeddedness.

5.2. Socio-spatial embeddedness and the restabilization of the industry

5.2.1. Territorial and societal embeddedness

The industry has strong territorial ties with the Ida-Virumaa region in north-eastern Estonia where all the oil shale deposits lie (figure 8). The abundance of oil shale in the area has led to regional technological specialization, demonstrated by the concentration of all power plants and oil factories in the same region, to the extent that not only the region but the whole country is heavily reliant on oil shale (Holmberg 2008).

The territorial ties between the industry and the region have in turn culturally and societally embedded the industry on regional and national scales. This is evident from the arguments and rhetoric that both industry actors and policymakers have used in support of the oil shale industry over the years (figure 6). Based on the case study, we can distinguish between at least three different cultural meanings of oil shale: 1) as national wealth; 2) as a guarantee of energy security and independence; 3) as a vital "backbone" of the regional economy to avoid an unemployment crisis.

The prevalence of these culturally embedded meanings can be illustrated with several examples from different periods of the study. During the heated debate over the expansion of mining areas in the second period (2003-2009), the Minister of Economic Affairs claimed that "oil shale is a gift from God" (Postimees, 28.02.2008) which "means energy security and […] that we will always have access to affordable electricity but also jobs and possibilities for the export of technology" (Postimees*,* 06.01.2011). Indeed, the association of oil shale with energy security has been a recurrent argument for the proponents of oil shale (see also figure 11), often overshadowing economic cost-benefit analysis. For example, the CEO of Eesti Energia has admitted that the construction of new oil shale power plants "was a political decision with the goal of increasing energy security but economically it was not a viable solution” (BNS, 27.10.2014). The importance of energy security has also regularly been linked to fears over national independence and sovereignty, with the Minister of Economic Affairs stating that the EU could never “force us to give up oil shale [because] there are no alternatives and it is a matter of national security” (Postimees, 28.02.2008).

Table 2. Socio-spatial embeddedness of the Estonian oil shale industry on different geographical scales.

<table>
<tr><th rowspan="2">Type of embeddedness</th><th colspan="3">Geographical scale</th></tr>
<tr><th>Regional</th><th>National</th><th>Global</th></tr>
<tr><td rowspan="2">Territorial</td><td>Almost all oil shale fields, power plants and oil factories located in Ida-Virumaa</td><td rowspan="2"></td><td rowspan="3"></td></tr>
<tr><td>Regional technological and industrial specialization</td></tr>
<tr><td>Societal</td><td colspan="2">Cultural meaning of oil shale as
1) national wealth enabling global technology export,
2) guarantee of energy security and independence,
3) vital "backbone" of the regional economy and
crucial to avoid an unemployment crisis</td></tr>
<tr><td rowspan="3">Network</td><td rowspan="3">Regular political support by the mayor of the mining town Kiviõli for the local chemical plant against the national government’s plans of limiting mining permits and increasing taxes (2003, 2007, 2011)</td><td>Goals of national development plans for oil shale influenced by demands of industry lobby group</td><td rowspan="2">Industry made sensitive to the fluctuations of the world crude oil price by its position in global value chains and production networks</td></tr>
<tr><td>Strategic investments of state-owned Eesti Energia controlled and steered by the Minister of Economics</td></tr>
<tr><td>Regular reactive policy support by the national government for industry during economic downfalls (2009, 2014-2016)</td><td>National climate and energy policies strongly influenced by multi-level governance (EU and UN)</td></tr>
</table>

Interestingly enough, the meaning of “energy security” was rarely disputed by policymakers and was almost always regarded as synonymous with an oil shale based energy system. There was some criticism from the oppositional Social Democratic Party who pointed out that the prevailing meaning of “energy security” is based on an unaccounted fear towards Russia and that new oil shale power plants “do not actually increase our energy security in any way” (Delfi, 28.10.2012). They suggested that real energy security for Estonia lies in a decentralized energy system based on renewables and good overseas connections (Delfi, 17.10.2012; see also figure 12).

Lastly, the oil shale industry has also been seen as an irreplaceable source of employment opportunities in the region. This meaning was, for example, conveyed by the president who referred to miners as “the backbone of Ida-Virumaa” (Postimees, 26.08.2007) and the mayor of Kiviõli, one of the mining towns, who stressed that the dissolution of the industry would lead the whole city into a “social catastrophe” (Postimees, 07.08.2007). Overall, these findings shed light on the importance of cultural „storylines” in facilitating or hindering industry phase-out and are in line with similar results from other recent studies (see Rosenbloom, 2018).

5.2.2. Network embeddedness

There is more variety in network embeddedness across regional, national and global scales as these ties can connect actors regardless of their anchoring in particular places. For example, activists have drawn on developments in the global civil society (increasing climate change agenda) and transnational advocacy networks (establishment of the Green Party and the Renewable Energy Council). Global value chains and production networks have influenced both new entrants (increasing cost-competitiveness of renewables) and the oil shale industry (fluctuating world crude oil price). In addition, the unique technological know-how on oil shale utilization has proved to be a lucrative global export opportunity for the incumbent industry and provided another justification for further investments into oil shale. As for policymakers, national legislation has depended on the decisions of international governance bodies such as EU (Industrial Emissions Directive) and UN (Kyoto protocol and Paris agreement).

However, the most distinctive evidence of network ties can be found on regional and national scales where the strong alliance between the industry and policymakers has largely neutralized the pressure from global connections such as fluctuations in world crude oil price and international climate and energy policies. This was manifested in the regular provision of favourable *ad hoc* political regulations (such as tax cuts and free mining permits) by the national government for the industry-in-need during economic downfalls in the first and fourth period as well as more strategic decisions (from national development plans to strategic investments of the state-owned Eesti Energia) in favour of the industry (table 1). The policy-industry alliance enabled the industry to ignore the climate change issue and the increasing cost-competitiveness of renewables (by dismissing the multiple alternative energy plans proposed by environmental organizations in the first, second and third period) and to continue business as usual or even expand production (by investing into new power plants, oil factories and mines in the third period) instead of diversification and reorientation.

5.2.3. Disclosing the restabilization strategies

In general, our findings show that the industry actors made use of three main types of strategies (drawing on territorial, societal and network embeddedness respectively) to counter the influence of destabilizing pressures. The first option for the industry was to reinforce its territorial ties by 1) intensifying the usage of existing resources and infrastructure and; 2) diversifying into regionally related activities. In the case at hand, these strategies were demonstrated by the construction of new oil (Eesti Energia, VKG) and lime factories (VKG) which were made possible by the abundance of mining fields and previous investments into technological know-how and in turn increased the lock-in to oil shale on regional and national scales.

Secondly, the industry increased its societal embeddedness by 1) emphasizing established cultural meanings and discourses through campaigns and; 2) incorporating new and emerging values into the existing ones in a symbolic fashion. Examples of the first strategy have already been covered throughout the paper, with the most notable of them being the campaign “Our welfare lies in our natural resources!” (see figure 11). The symbolic adoption of emerging values was manifested when Eesti Energia (2013), VKG (2009) and Kunda Nordic Tsement (2012) started issuing annual reports of corporate social responsibility and sustainable development (emphasizing the industry’s increasing contribution to the local communities and environment) while at the same time expanding energy and oil production. Therefore, the symbolic notions of sustainability and responsibility were employed to distract the public from the fact that substantial changes in technologies were avoided and the industry was continuing on the already established path. This was true not only for the industry but also for policymakers, with the Prime Minister coming out with the highly debatable claim that the objectives of the Paris climate agreement and Estonia's new oil shale development plan were entirely compatible (Postimees, 16.12.2015).

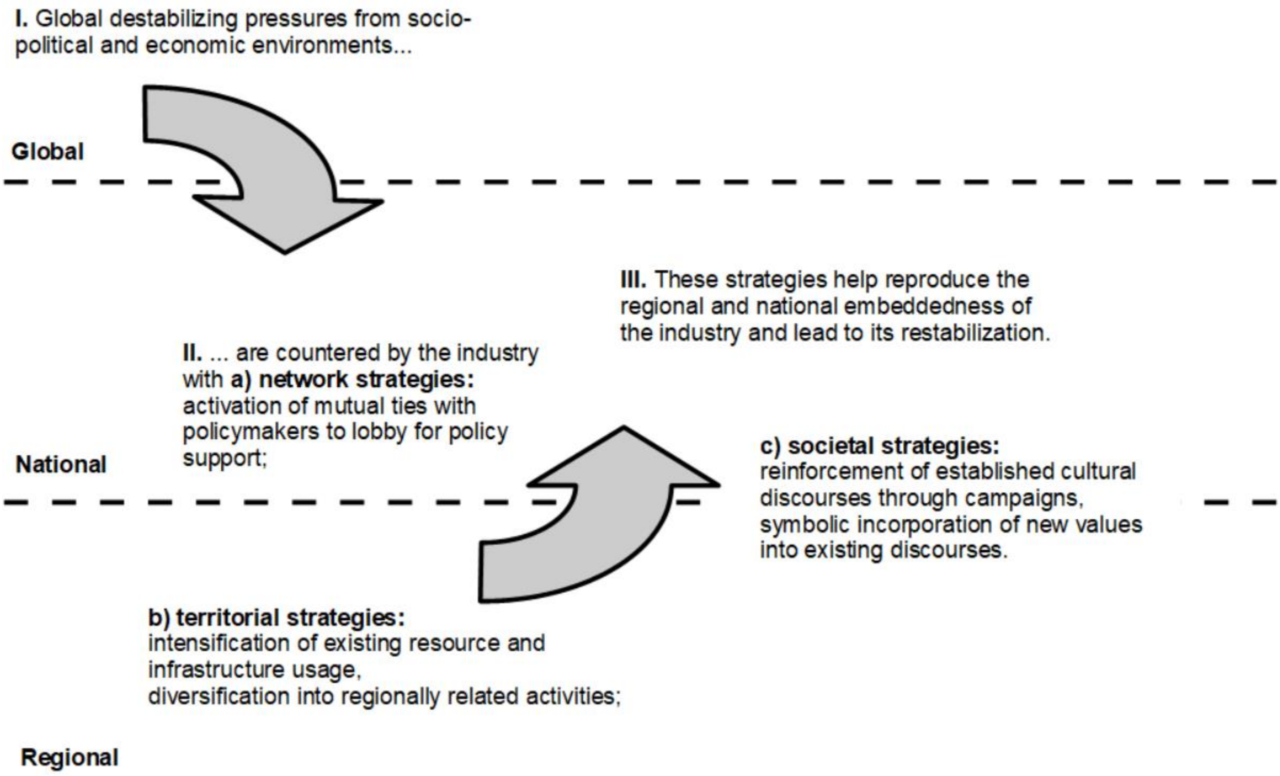

Figure 13. Strategies of industry restabilization through the reproduction of regional and national embeddedness.

Thirdly, the industry drew on network embeddedness by activating ties with regional and national policymakers to lobby for policy support, thus reinforcing the pre-existing policy-industry alliance. Our case study showed this happen on numerous occasions, with the industry pleading for changes in environmental charges, free mining permits and the postponement of EU policies during the downfalls in world oil price. In combination, all of these strategies helped neutralize the impact of destabilizing pressures and contributed to the restabilization of the industry on regional as well as national scales. Figure 13 provides a visual summary of these strategies and their impact on different scales.

5.3. Interaction of destabilizing and stabilizing mechanisms

Overall, our analysis shows that the global pressure of climate change conceptualized by the DILC model is not necessarily in line with regional and national dynamics. This became especially visible during the fourth period (2014-2016) when economic and socio-political pressures on the industry aligned but were effectively muted by the policy-industry alliance on regional and national scales. We therefore conclude that the interaction of destabilizing (DILC) and stabilizing (socio-spatial embeddedness) mechanisms has led to a misalignment of pressures across global, national and regional scales and rendered the overall destabilization of the industry unable to move beyond phase 4 of the DILC model. In effect, the national and regional scales have functioned as "filters" for alleviating the impact of broader pressures and stabilizing the industry. Consequently, there have been no substantial changes neither in national and regional development strategies nor in the actual reorientation of the incumbent industry.

6. Conclusions and policy implications

In this study, we combined the Dialectic Issue LifeCycle (DILC) model and the literature on socio-spatial embeddedness to answer the following research questions: 1) what are the main forms of socio-spatial embeddedness of industries on different geographical scales and how do they affect industries? 2) how do global pressures interact with regional and national embeddedness and what is the result of this interaction for industry destabilization?. The main findings, based on a case study of the Estonian oil shale industry between 1995-2016, are as follows:

1. industries are simultaneously embedded on multiple scales and in different ways, with territorial embeddedness operating on the regional scale, societal embeddedness extending to the national scale and network embeddedness being present on all three scales. We uncovered three main types of strategies that industries can use to reproduce the different forms of embeddedness and restabilize themselves when in need. Territorial strategies include the

intensification of natural resource and infrastructure usage and regionally related diversification; societal strategies include the reinforcement of established cultural discourses or the symbolic incorporation of new values into existing discourses; and network strategies include the activation of pre-established ties between policy and industry to achieve favourable regulation. In combination, these strategies serve as a powerful source of stabilization for incumbent industries, enabling them to ignore challenges and increase investments in favourable economic conditions and obtain immediate political support during crises;

2. the DILC model performs well in describing the increasing pressure by activists (increasing climate change agenda) as well as consumers and new entrants (increasing cost-competitiveness of renewables) but fails to explain why policy-makers and industry incumbents often try to address both the climate change issue and continue investments into fossil fuels. We find that the regional and national embeddedness of industries, and especially the strong policy-industry alliance, make it difficult for policymakers to fully commit to the destabilization of incumbent industries and force them to "hedge the bets" instead, leading to a cyclical back-and-forth movement between DILC phases;
3. hence in contrast to what the DILC model implies, there is no straightforward transmission of global pressures on local industries as the territorial, societal and network embeddedness on national and regional scales can largely "filter out" their destabilizing impact. This leads to a misalignment of pressures on different scales where the gradual increase in global pressures has only a weak destabilizing effect on the industry due to its strong ties on regional and national scales.

Our findings have three broader implications for policymakers concerned with transitions to sustainability. First, echoing the recent advances in the geography of transitions (Boschma et al., 2017), we want to stress the place-dependence of industrial development which, in the context of redirecting unsustainable industries, indicates a need to focus not only on destabilization (decoupling the industry from the dominant socio-technical regime) but also disembedding strategies (decoupling the industry from its surrounding environment). Although these strategies warrant further analysis, we can speculate on three ways of disembedding that, in the Estonian context, would facilitate a move towards the substantial reorientation of the industry:

1. decoupling the industry from its territorial ties such as natural resources and regional technological specialization. This strategy is obviously difficult for industries like VKG that rely on the extraction of natural resources in specific regions as their main activity. In the Estonian case, the option for VKG is to shift its specialization into oil-shale-based chemicals or building materials the production of which is both less polluting and more profitable than power generation. The activities of the energy-oriented Eesti Energia, on the other hand, can in principle be completely decoupled from oil shale and reoriented towards renewables;

2. reframing societal problems and cultural meanings related to the industry, including its resources and technologies. For example, one of the campaigns by the Estonian Green Movement (see figure 12) attempted to renegotiate the connection between oil shale and energy security, linking the latter to renewables instead. Strategies like these can help legitimize alternative solutions in society;

3. breaking old network ties and creating new ones across all scales. This means that activists and new entrants need to become even more engaged in the global movement towards sustainability in order to transform the policy-industry alliance that is currently blocking the renewable energy transition. This can be done in various ways on different scales, including 1) increasing the visibility of regional activists and environmentally minded citizens, 2) appointing “green” politicians to strategically important positions in the national government (e.g. as Minister of Economics) or 3) lobbying the EU so that it would apply more pressure on the national government to take steps towards a renewable energy transition.

Second, policies on different scales need to be aligned, meaning that global agreements have to be supported by appropriate regional innovation policies and diversification strategies. These may range from: 1) regime incumbents developing a new regionally unrelated industry, 2) niche actors building on existing regional capacities or 3) new niche actors entering the regional market with an unrelated technology (Boschma et al., 2017). In the case of Ida-Virumaa, there is a possibility of combining these strategies that would benefit both the incumbent regime as well as the renewable energy niche. In fact, Eesti Energia has been experimenting with wind energy in the same region for over two decades and they have also recently acquired the majority of shares in the largest wind energy enterprise in the country (Eesti Energia, 2018), thereby incorporating part of the emerging niche into the incumbent regime.

Lastly, we wish to call attention to an often overlooked dimension in transition policies, namely the negative spill-over effects of destabilizing heavily embedded industries, as reflected in the prevalence of concerns about energy security and unemployment in the Estonian case. Moreover, a rapid and deep decarbonization over the next decade would heavily disrupt existing socio-technical systems and bring about even more uncertainty and disbalance than previous system transitions (Geels et al., 2017). Policy measures such as providing mass retraining programmes or early retirement benefits for out-of-work miners in politically unstable regions are crucial if rapid decarbonization of existing unsustainable systems is to be achieved with minimum collateral damage.

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Appendix A. Coding manual for the content analysis of newspaper articles

1. Overall parameters of the text

A0 Number

A1 Date

A2 Publisher

A3 Headline

A4 Whose views are mainly represented in the article?

1 Journalist

2 Environmental activist

3 Politician or government official

4 Industry representative

5 Renewable energy entrepreneur

6 Scientist

7 Other

2. Manifestations of evidence on industry destabilization

B1 Activism and issue framing

1 Climate change is mentioned as an issue

2 An organization or movement concerned with climate change is mentioned

3 Public opinion towards climate change is mentioned

4 New climate policies are advocated

5 Other

6 None of the above are mentioned

B2 Politics and policy

1 The creation of an informal committee concerned with climate change is mentioned

2 Formal hearings in the parliament about climate change are mentioned

3 New climate policies are mentioned

4 Changes in economic frame conditions are mentioned

5 Other

6 None of the above are mentioned

B3 Supply and demand

1 Rising renewable energy demand is mentioned

2 A renewable energy market niche is mentioned

3 Changes in mainstream preferences of energy use are mentioned

4 Other

5 None of the above are mentioned

B4 Industry strategies

1 Climate change is denied

2 The seriousness of climate change is downplayed

3 A closed industry front is mentioned

4 The claims of climate activists are contested

5 An incremental technological solution by a firm in the oil shale industry is mentioned

6 Renewable energy technologies are portrayed as unfeasible

7 Investment into renewable energy by a firm in the oil shale industry is mentioned

8 New climate policies are opposed

9 Diversification by a firm in the oil shale industry into new product markets is mentioned

10 Substantial technological or regulative changes by a firm in the oil shale industry are mentioned

11 Substantial changes in the mission or identity of a firm in the oil shale industry are mentioned

12 The bankruptcy of a firm in the oil shale industry is mentioned

13 Other

14 None of the above are mentioned

3. Manifestations of evidence on socio-spatial embeddedness

C1 Alternative issue framings

1 Energy security

2 Employment

3 Low oil price

4 Tax revenue from the oil shale industry

5 Oil shale as the national wealth

6 Environmental damage (other than climate change)

7 Hidden subsidies for the oil shale industry

8 Decreasing oil shale reserves

9 Inefficiency of oil shale as an energy source

10 Natural habitats of the flying squirrel

C2 Alternative energy policies proposed and /or implemented

1 Decentralisation of energy production

2 Limiting the oil shale mining capacity

3 Renewable energy subsidies

4 Privatisation of energy companies

5 Temporary status for oil shale industry by the EU

6 Temporary reduction of environmental taxes for the oil shale industry

7 Taxing based on the world crude oil price

C3 Alternative energy sources proposed

1 Nuclear

2 Wind

3 Solar

4 Woodchips

5 Other biofuels (including waste)

6 Renewable energy sources in general

7 All alternatives depicted as infeasible

C4 Alternative industry strategies

1 Opening a new oil shale mine

2 Establishing a new power plant

3 Establishing a new oil factory

4 Cutting costs by laying off employees